KEPLER

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters	)	IB Docket No. 16-408
	)	
	)	

KEPLER'S COMMENTS ON
NOTICE OF PROPOSED RULEMAKING

Kepler Communications Inc. (Kepler)[1] is pleased to submit its comments in response to the Commission's Notice of Proposed Rulemaking ("NPRM")[2] seeking comment on proposed changes to the regulations surrounding the use of large non-geostationary satellite orbit (NGSO) fixed-satellite service (FSS) systems.

Itemized below, in line with the structure laid out by the Commission are Kepler's recommendations, comments and concerns.

A. Ka-band Plan

1. The Commission's proposal to migrate policies that have typically been granted, through the use of waivers, over to the regulatory framework/tables is a valuable change that will streamline the process of planning and implementing systems. Such simplification will also facilitate new entrants and encourage diversification across the bands for both GSO and NGSO alike. Ultimately, the introduction of regulations that are in favour of previously implemented waivers will result in more efficient use of spectrum and encourage incumbent systems to invest in technologies and methods to work in unison with existing systems. Kepler strongly supports this transition.

[1] The Kepler System is an innovative new paradigm for satellite communications. It leverages nearly 16 years of on-going development towards the CubeSat standard. Using this standard in combination with a novel, proprietary, Software Defined Radio ("SDR") and electronically steerable antenna array, the Kepler System will deliver cost effective real-time connectivity for the billions of devices that gather the world's information. The complete system will be in operation by 2022 with the first two spacecraft already manifested for launch in 2017. Providing low-cost real-time connectivity through the Kepler System will be a key enabler to realizing the true economic potential of the data gathered by devices on the ground and satellites deployed in space

[2] *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, IB Docket No. 16-408 (Dec. 15, 2016)

2. As an additional method to sharing of spectrum, system operators could specify time slots for frequency use. This would be useful in the event that a system does not have global coverage and is attempting to coordinate with a larger system that has the capability of altering its centre frequencies and bandwidths. In essence, this would be an expansion to the inline interference policy and is further discussed below.

B. EPFD Limits

3. In order to simplify and streamline the process of license issuance/acquisition, the call to align the Commission's regulations with those set forth in Article 22 of the ITU Radio Regulations is seen as positive. Such an alignment would further reduce the requirement for, and uncertainty surrounding waivers.
4. Provided that the Commission continues to have bands exclusive to the NGSO, or where NGSO are Primary and GSO Secondary, the proposal for Default Sharing makes sense. Since NGSO can provide a number of low cost and low latency services that GSO systems are note capable of, such a reservation is essential for further development. Furthermore, where new technology can provide the means to facilitate spectrum sharing without interference, regulations should enable systems to do so.

C. Avoidance of In-line Interference

5. The Commission has noted it seeks comment on the collection of Ephemeris Data and the period at which such data is updated. Kepler intends to provide its Ephemeris Data in *JSON*[3] format and subsequently provide a *web hook*[4] option for third parties wishing to receive updated information as it becomes available. The *web hook* could subsequently trigger a function call on the operator's server to verify whether this new data poses any risk to its own system and notify them accordingly. Rather than pushing operators to conform to a local standard, the Commission should work with other jurisdictions and possibly the ITU, to establish a standard or open source framework for publishing the data and triggering update notifications.

[3] JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999. JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others. These properties make JSON an ideal data-interchange language., *See http://www.json.org*

[4] A webhook in web development is a method of augmenting or altering the behavior of a web page, or web application, with custom callbacks. These callbacks may be maintained, modified, and managed by third-party users and developers who may not necessarily be affiliated with the originating website or application. *See https://en.wikipedia.org/wiki/Webhook*

6. With regards to the *Accommodation of Later Entrants*, the Commission should account for several key factors (amongst others) when authorizing a space station – namely the bandwidth the system intends to occupy, the technology implemented to facilitate coordation with both present and future systems and the time the system intends to occupy the desired bandwidth.

   As an example, the licensing of the entire Ku band spectrum in both the up and down FSS service to a single operator may make sense only in the instance where said system is capable of dynamically altering its center frequencies, bandwidths and beam pointing to accommodate other systems currently present and those looking to enter in the future. Failure to restrict a system which is incapable of accommodating future entrants would result in a rapid deterioration in the progress of the industry due to the allocation of a scarce resource to a select few.

   Shutting out future entrants to any market must be avoided to ensure that there is incentive for new systems to continue innovating and pushing the boundaries in the efficient use of spectrum and space systems. As a guideline, spectral priority should be given to those systems that facilitate simplified coordination through the use of dynamic technology with both new[5] and existing systems. In doing so, the Commission will encourage new entrants to use the latest technology possible and place a non-monetary tax on the use of dated technologies or systems that inhibit new entrants. The allocation of a "home" spectrum (if continued) could subsequently be a function of the system's ability to coordinate with future entrants, requested bandwidth and entrants in a processing round. Priority for non "home" spectrum would thus become a function of filing date and ability to accommodate inline events with other systems by means other than ceasing emissions[6].

   Such a system for prioritization would be undermined if ill-defined and would likely result in lost time by all parties involved. However, if such a system were to be effectively thought out and implemented – it would drive continuous investment and innovation within the industry, ensuring that the Public's interest is accounted for first and foremost.

[5] Refers to entrants that may be entering the market under the same processing round as well as entrants that may enter subsequent rounds thereafter.

[6] *For example:* The technical ability to split the bandwidth 50/50 with the incumbent, change center frequency, narrowing beamwidth, etc.

7. Kepler is aware of the comments and replies from SkyBridge, Hughes, Teledesic, Boeing and Virtual Geo in the Ku-band rulemaking[7], definition of in-line interference event (para. 40). While we have not had time to review the previous ruling and comments in detail, Kepler is of the general belief that a strict 10-deg separation trigger point[8] will cause excessive work for operators in the NGSO to coordinate. This is especially true now that there is a significantly larger number of players poised to enter the market. Kepler supports the commission's sentiment in the original rulemaking[9], that smaller angles of separation can and should be negotiated during coordination between the parties. Additionally, we recommend newer technologies, such as cognitive radios that can detect and utilize available communication channels dynamically and beam-forming antenna that can form pencil beams as well as null points be prioritized during the coordination process given that they significantly increase the overall spectrum efficiency across all satellite operators[10]. While the Commission originally agreed with the arguments put forward by SkyBridge, Kepler is of the notion that in implementing new technologies the capabilities of satellites to coordination has since improved drastically. As such and given its objectives[11], the Commission must introduce negative externalities toward the use of dated technology that hordes spectrum rather than facilitate the growth of competitors within the industry both now and in the future.

D. Milestones

8. The Commission must differentiate between multibillion dollar organizations launching all satellites concurrently and smaller enterprises entering the market with a phased approach. As noted by Space X[12], the bond should be a function of the scale and cost of the proposed system. For smaller entities using Nano satellites in a proposed technical validation phase[13], the

[7] The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band, IB Docket No. 01-96

[8] With regards to an inline interference event.

[9] The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band, IB Docket No. 01-96 – *para. 40*

[10] Strategic goal 1.1.1: *Pursue spectrum allocation and license assignment policies to achieve the effective and efficient use of spectrum […], See FCC Strategic Plan 2015-2018 - https://apps.fcc.gov/edocs_public/attachmatch/DOC-331866A1.pdf*

[11] Strategic goal 1: *Promote the expansion of competitive telecommunications networks […], See FCC Strategic Plan 2015-2018 - https://apps.fcc.gov/edocs_public/attachmatch/DOC-331866A1.pdf*

[12] Space Exploration Technologies Corp. (Space X) suggested such a 75 percent completion milestone. See SpaceX Reply, IB Docket No. 12-267

[13] This is not intended to replace the experimental license structure wherein generating service revenue is not permitted, *See §5.602 (a)*. Instead, the intent is to provided operators a means of testing a subset of their system, with clients, while generating revenue. Such a system deployment assists new entities in staggering financing rounds, providing less risk to investors which will directly translate to increased investor confidence and further

introduction of a $5 million bond is likely to exceed the actual value of the entire system. As such, Kepler would suggest the following amendment to accommodate the nanosat economy:

- $500,000[14] (1-5 nano[15] satellites)
- $5 million (1-99 satellites)
- $10 million (100-999 satellites)
- An additional $5 million for each additional 1,000 satellites

Furthermore, it is recommended that licences issued to constellations or phases of constellations using 5 or less nano satellites have their bond requirement waved after the bringing into use (BIU) of the first satellite. From a spectrum priority standpoint, the operator should still be required to follow the recommendation of Space X, tentatively adopted by the commission, wherein 75% of the system must be BIU by year 6 and 100% by year 9. In the event of a subsequent phase of deployment exceeding the initial 5 satellite limit, the operator in question would be required to follow the normal bond procedure as tentatively adopted by the commission at the start of its subsequent deployment phase. The above proposal enables new entrants with nano satellite proposals to test their system without undue burden from a disproportionately high priced bond without risk to other operators in regard to potential spectrum hording.

E. Geographic Coverage

9. Kepler agrees with the Commission's proposal to eliminate the requirement for 18 hour a day global coverage in the 10.7-14.5 GHz, 18.8-19.3 GHz, or 28.6-29.1 GHz bands. Where a system is unable to provide global coverage, other systems are likely to capitalize on the available spectrum. Systems not providing global coverage must be required to coordinate with other operators to allocate free spectrum when not in use. This is especially true for smaller satellites that may not be capable of emitting on a continuous basis, hence the recommendation in point A) 3) of this document.

investment in the space market. Ultimately, the ability to generate revenue during a trial phase will lead to greater research and development in the industry.

[14] Such a bond could easily exceed 100% of the capital required to construct and launch a 3U nano satellite. Alternatively, the Commission could adopt a cost structure based on the following function for 5 nano satellites or less: *Bond in USD = 35000 x N x U* Where *N* is the number of satellites being launched and *U* the size of the satellite as a multiple of (10x10x11.35 cm). *U* could alternatively be replaced by a volumetric divisor, *V/U*, where V is the volume of the satellite and *U* the divisor (similar to how postal systems have a volumetric weight system).

[15] Likely to be defined as a satellite up to 6U in size (U being the multiple of 10x10x11.35 cm) and under 10 kg in weight.

Respectfully submitted,

Kepler Communications Inc. - February 27, 2017
By: __/s/ *Nickolas G. Spina*_____

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